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TITLE: Method and apparatus for converting image information

Brief Summary Text (3):
The present invention relates to a method and apparatus for converting image information in such a manner that an orthogonal transform is performed on a block-by-block basis, and orthogonal transform coefficients obtained via the orthogonal transform for each block are then quantized thereby converting the bit rate of image information which has been coded into a compressed form, wherein each block is a predefined pixel block called an orthogonal transform block. For example, when image information coded into a compressed form according to the MPEG-2 standard or the like is transmitted via a network for satellite broadcasting, cable television, or the like or when such image information is recorded on a recording medium such as an optical disk or a magnetic disk, the present invention is advantageously employed to reduce the bit rate of the compressed image information.

Brief Summary Text (9):
FIG. 41 illustrates a conventional image information conversion apparatus, including an image decoder 110 and an image coder 120, for reducing the code size (bit rate) of compressed image information (bit stream).

Brief Summary Text (10):
In this conventional image information conversion apparatus, compressed image information (bit stream) with a high bit rate is input to the image decoder 110. The image decoder 110 decodes the compressed image information with the high bit rate into baseband video data. The resultant baseband video data is applied to the image coder 120. The image coder 120 codes the baseband video data received from the image decoder 110 into compressed image information (bit stream) with a low bit rate. A target code size (target bit rate) smaller than the code size of the input compressed image information is set in the image coder 120, and the image coder 120 performs quantization corresponding to the target code size.

Brief Summary Text (11):
By performing the above-described process, the conventional image information conversion apparatus reduces the code size of compressed image information.

Brief Summary Text (12):
However, in the conventional image information conversion apparatus, because the entire decoding and coding processes are performed, a large scale hardware system is required. As a result, such image information conversion apparatus is expensive and consumes high electric power. Therefore, it is difficult to install such apparatus in consumer devices or portable devices. Furthermore, in the conventional image information conversion apparatus, it is required to completely perform all processes associated with decoding and coding, and thus a very large amount of calculation is required. When processes are performed by software with a general-purpose integrated circuit, the processes cannot be completed in real time if the circuit does not have high enough performance.

Brief Summary Text (13):
Furthermore, in the conventional image information conversion apparatus 120, in

order to convert the input compressed image information with a high bit rate into information having a smaller target code size (target bit rate) than the code size of the input information, the input information is re-quantized using a large quantization step value. As a result, large quantization noise appears as block noise in the decoded image, and thus high image quality cannot be obtained.

Brief Summary Text (14):
Thus, an object of the present invention is to solve the problems described above. More specifically, the object is to provide a method and apparatus for converting image information in such a manner as to reduce the large code size (high bit rate) of the input compressed image information (bit stream) without causing significant degradation in image quality in the decoded image, and outputting the resultant compressed image information with the reduced code size (lowered bit rate).

Brief Summary Text (16):
According to an aspect of the present invention, there is provided an image information conversion apparatus for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than the first bit rate, the first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by the orthogonal transform, within the block, each block being a predetermined pixel block (orthogonal transform block), the image information conversion apparatus comprising: dequantization means for dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; and quantization means for re-quantizing the orthogonal transform coefficients dequantized by the dequantization means, using a quantization step value which is set-so that the output second compressed image information has the second bit rate.

Brief Summary Text (17):
In this image information conversion apparatus, the orthogonal transform coefficients are dequantized and the resultant dequantized orthogonal transform coefficients are re-quantized using a different quantization step value.

Brief Summary Text (18):
The image information conversion apparatus may further comprise band limiting means for limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized by the dequantization means, wherein the quantization means re-quantizes the orthogonal transform coefficients including motion compensation error correction coefficients added by the addition means, using a quantization step value which is set so that the output second compressed image information has the second bit rate.

Brief Summary Text (19):
In this image information conversion apparatus, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization is performed using a different quantization step value.

Brief Summary Text (20):
According to another aspect of the present invention, there is provided an image information conversion apparatus for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than the first bit rate, the first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by the orthogonal transform, within the block, each block being a predetermined pixel block (orthogonal transform block), the image

information conversion apparatus comprising: first dequantization means for dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; addition means for adding motion compensation error correction coefficients to the orthogonal transform coefficients dequantized by said first dequantization means; quantization means for re-quantizing the orthogonal transform coefficients including motion compensation error correction coefficients added by the addition means, using a quantization step value which is set so that the output second compressed image information has the second bit rate; second dequantization means for dequantizing the orthogonal transform coefficients re-quantized by said quantization means; subtraction means for subtracting the orthogonal transform coefficients including motion compensation error correction coefficients added by the addition means from the orthogonal transform coefficients dequantized by the second dequantization means; and motion compensation error correction means for generating the motion compensation error correction coefficients by means of: performing an orthogonal transform upon the subtracted orthogonal transform coefficients and performing motion compensation in accordance with a motion vector; and performing an inverse orthogonal transform upon the motion-compensated values.

Brief Summary Text (21):
In this image information conversion apparatus, the orthogonal transform coefficients are dequantized and then re-quantized using a different quantization step value, and, furthermore, motion compensation is performed upon the difference between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation.

Brief Summary Text (22):
This image information conversion apparatus may further comprises band limiting means for limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized by the first dequantization means, wherein the quantization means re-quantizes the orthogonal transform coefficients including motion compensation error correction coefficients added by the addition means, using a quantization step value which is set so that the output second compressed image information has-the second bit rate;

Brief Summary Text (23):
In this image information conversion apparatus, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization is performed using a different quantization step value, and furthermore, motion compensation is performed upon the difference between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation.

Brief Summary Text (24):
In the image information conversion apparatus, the orthogonal transform coefficients may consist of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, that is, 8.times.8 coefficients, and the motion compensation error correction means may comprise: a 4.times.8 inverse orthogonal transformer for performing a 4.times.8 inverse orthogonal transform upon quantization error coefficients consisting of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, thereby generating quantization error values in the space domain; a motion compensator for performing motion compensation upon the space-domain quantization error values generated by the 4.times.8 inverse orthogonal transformer, with precision of 1/4 pixels in the horizontal direction and 1/2 pixels in the vertical direction thereby generating quantization error correction values in the space domain; and a 4.times.8 orthogonal transformer for performing a 4.times.8 orthogonal transform upon the space-domain quantization error correction values generated by the motion

compensator thereby generating the motion compensation error correction coefficients in the frequency domain.

Brief Summary Text (25):
In this image information conversion apparatus, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization is performed using a different quantization step value, and furthermore, motion compensation is performed upon differential values between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients, for low-frequency 4 coefficients in the horizontal direction and 8 coefficients in the vertical horizontal direction thereby correcting errors caused by motion compensation.

Brief Summary Text (26):
According to another aspect of the present invention, there is provided an image information conversion method for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than the first bit rate, the first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by the orthogonal transform, within the block, each block being a predetermined pixel block (orthogonal transform block), the image information conversion method comprising the steps of: inputting the first compressed image information with the first bit rate; dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; re-quantizing the orthogonal transform coefficients dequantized in the dequantization step, using a quantization step value which is set so that the output second compressed image information has the second bit rate; and outputting the second compressed image information generated in the re-quantization step.

Brief Summary Text (27):
In this image information conversion method, the orthogonal transform coefficients are dequantized and the resultant dequantized orthogonal transform coefficients are re-quantized using a different quantization step value.

Brief Summary Text (28):
In this image information conversion method, high-frequency component values, in the horizontal direction, of the dequantized orthogonal transform coefficients may be limited, and the orthogonal transform coefficients limited in terms of the high-frequency components may be re-quantized using a quantization step value which is set so that the output second compressed image information has the second bit rate.

Brief Summary Text (29):
In this image information conversion method, when the re-quantization is performed after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, a different quantization step value is employed in the re-quantization.

Brief Summary Text (30):
According to still another aspect of the present invention, there is provided an image information conversion method for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than the first bit rate, the first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by the orthogonal transform, within the block, each block being a predetermined pixel block (orthogonal transform block), the image information conversion method comprising the steps of: inputting

the first compressed image information with the first bit rate; dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; adding motion compensation error correction coefficients to the dequantized orthogonal transform coefficients; re-quantizing the orthogonal transform coefficients including motion compensation error correction coefficients added in the addition step, using a quantization step value which is set so that the output second compressed image information has the second bit rate; outputting the second compressed image information generated in the re-quantization step, generating the motion compensation error correction coefficients by means of: dequantizing the re-quantized orthogonal transform coefficients; subtracting the orthogonal transform coefficients including the added motion compensation correction coefficients from the dequantized orthogonal transform coefficients; performing an orthogonal transform upon the subtracted orthogonal transform coefficients and performing motion compensation in accordance with a motion vector; and performing an inverse orthogonal transform upon the motion-compensated values.

Brief Summary Text (31):
In this image information conversion method, the orthogonal transform coefficients are dequantized and the resultant dequantized orthogonal transform coefficients are re-quantized using a different quantization step value, and, furthermore, motion compensation is performed upon the difference between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation.

Brief Summary Text (32):
In the image information conversion method, high-frequency component values, in the horizontal direction, of the dequantized orthogonal transform coefficients may be limited, and the orthogonal transform coefficients limited in terms of the high-frequency components may be re-quantized using a quantization step value which is set so that the output second compressed image information has the second bit rate.

Brief Summary Text (33):
In this image information conversion method, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization is performed using a different quantization step value, and furthermore, motion compensation is performed upon the difference between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation.

Brief Summary Text (34):
In the image information conversion method, the orthogonal transform coefficients may consist of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, that is, 8.times.8 coefficients, and the frequency-domain motion compensation error correction coefficients may be generated by means of: performing a 4.times.8 inverse orthogonal transform upon quantization error coefficients consisting of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, thereby generating quantization error values in the space domain; performing motion compensation upon said space-domain quantization error values, with precision of 1/4 pixels in the horizontal direction and 1/2 pixels in the vertical direction thereby generating quantization error correction values in the space domain; and performing a 4.times.8 orthogonal transform upon the quantization error correction values in the space-domain.

Brief Summary Text (35):
In this image information conversion method, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization is performed using a different

quantization step value, and furthermore, motion compensation is performed upon differential values between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients, for low-frequency 4 coefficients in the horizontal direction and 8 coefficients in the vertical horizontal direction thereby correcting errors caused by motion compensation.

Drawing Description Text (29):
FIG. 28 is a block diagram illustrating a first embodiment of an image information conversion apparatus according to the present invention;

Drawing Description Text (30):
FIG. 29 is a schematic diagram illustrating examples of the process of limiting high-frequency components of discrete cosine transform coefficients in the horizontal direction, performed by a band limiter of the image information conversion apparatus, wherein FIG. 29A illustrates an example of a band limitation for discrete cosine transform coefficients of a luminance signal, and FIG. 29B illustrates an example of a band limitation for discrete cosine transform coefficients of a color difference signal;

Drawing Description Text (31):
FIG. 30 is a flow chart illustrating the operation of a code size controller of the image information conversion apparatus;

Drawing Description Text (33):
FIG. 32 is a block diagram illustrating a second embodiment of an image information conversion apparatus according to the present invention;

Drawing Description Text (35):
FIG. 34 is a block diagram illustrating a third embodiment of an image information conversion apparatus according to the present invention;

Drawing Description Text (42):
FIG. 41 is a block diagram illustrating a conventional image information conversion apparatus.

Detailed Description Text (2):
The present invention is described in further detail below with reference to embodiments of image information conversion apparatus capable of reducing the code size (bit rate) of compressed image information (bit stream) coded in accordance with the MPEG-2 standard. MPEG-2 (ISO/IEC138182) is a standard of a method of compressing image information, which is adapted to both interlaced scanning and sequential scanning and is also adapted to both standard resolution and high resolution.

Detailed Description Text (3):
Before describing the embodiment of the image information conversion apparatus according to the present invention, there are described an MPEG-2 image information coding apparatus for coding image information into a compressed form according to the MPEG-2 standard and the data structure of the MPEG-2 compressed image information.

Detailed Description Text (37):
The first assumption is that the average quantization scale code used in the coding for each picture times the generated code size (picture complexity) has a constant value depending on the picture type, as along as there is no change in the scene. After coding each picture, variables Xi, Xp, and Xb (global complexity measure) representing the picture complexity are updated in accordance with equation (4) described below.

Detailed Description Text (103):

First Embodiment of an Image Information Conversion Apparatus

Detailed Description Text (104):
Now, a first embodiment of an image information conversion apparatus according to the present invention is described below.

Detailed Description Text (105):
FIG. 28 is a block diagram of the first embodiment of the image information conversion apparatus according to the present invention. This image information conversion apparatus reduces the code size (bit rate) of given image information (bit stream) compressed according to the MPEG-2 standard and outputs the resultant compressed image information with a lower bit rate.

Detailed Description Text (106):
The image information conversion apparatus 20 shown in FIG. 28 includes a code buffer 23, a compressed image analyzer 24, a variable length decoder 25, an inverse quantizer 26, a band limiter 27, a quantizer 28, a variable length coder 29, a coder buffer 30, and a code size controller 31.

Detailed Description Text (120):
As described earlier with reference to FIG. 10, in the technique described in the MPEG-2 Test Model 5 (ISO/IEC JTC1/SC29/WG11 N0400) employed in the MPEG-2 image information coding apparatus, the target code size (target bit rate) is first calculated for each picture in accordance with information as to pictures (I-, P-, and B-pictures) of a GOP, and then coding is performed. However, in the present embodiment of the image information conversion apparatus 20, data is given as compressed image information (bit stream), and thus it is impossible to detect GOP information from the header information. Therefore, the technique described in the MPEG-2 Test Model 5 cannot be applied directly to the present image information conversion apparatus 20.

Detailed Description Text (121):
In the image information conversion apparatus 20, in view of the above, the code size assigned to an I-picture is first analyzed by the compressed image analyzer 24, as shown in FIG. 30 (step S11). The information indicating the code size assigned to the I-picture is sent to the code size controller 31. The code size controller 31 determines the target code size (target bet rate) T of the current picture, using the code size (B.sub.1) given by the compressed image analyzer 24, the bit rate R.sub.1 of the input bit stream, and the bit rate R.sub.2 of the output bit stream, in accordance with equation (26) described below (step S12). ##EQU7##

Detailed Description Text (124):
As described above, the image information conversion apparatus 20 first analyzes the code size assigned to the I-picture, and multiplies it by the ratio of the bit rate of the output compressed image information to that of the input compressed image information whereby the code size is controlled by the method described in the MPEG-2 Test Model 5 without needing information as to the GOP.

Detailed Description Text (131):
In the image information conversion apparatus 20 according to the first embodiment of the present invention, as described above, it is possible to reduce the code size (bit rate) by treating the data in each block in the frequency domain, and thus the amount of calculation becomes small compared with that required by the conventional image information conversion apparatus in which image information is decoded into baseband video data and then coded again. Therefore, it is possible to construct the image information conversion apparatus 20 into a very simple form.

Detailed Description Text (132):
In the above-described image information conversion apparatus 20, the band limiter

27 is disposed between the inverse quantizer 26 and the quantizer 28. However, the band limiter 27 may be removed, if the large reduction in the code size (bit rate) is not required.

Detailed Description Text (133):
Second Embodiment of an Image Information Conversion Apparatus

Detailed Description Text (134):
A second embodiment of an image information conversion apparatus according to the present invention is described below.

Detailed Description Text (135):
FIG. 32 is a block diagram of the second embodiment of the image information conversion apparatus according to the present invention. In this second embodiment of the image information conversion apparatus, similar elements to those of the first embodiment of the image information conversion apparatus 20 are denoted by similar reference numerals, and they are not described in further detail herein.

Detailed Description Text (136):
The image information conversion apparatus 40 shown in FIG. 32 includes a code buffer 23, a compressed information analyzer 24, a variable length decoder 25, an inverse quantizer 26, an adder 41, a band limiter 27, a quantizer 28, a variable length coder 29, a code buffer 30, a code size controller 31, and a motion compensation error corrector 42.

Detailed Description Text (142):
On the other hand, for pixels of inter macroblocks, when the code size (bit rate) is reduced by the image information conversion apparatus shown in FIG. 28, the inverse quantizer 26 and the quantizer 28 replaces the quantization step value Q.sub.1 for the difference value O-L(Q.sub.1) with Q.sub.2. In the decoding operation, pixels in the inter macroblocks whose code size has been reduced in the above manner are decoded on the assumption that the differential value O-L(Q.sub.2) has been coded using the quantization step value Q.sub.2.

Detailed Description Text (143):
Because the image information conversion apparatus 20 reduces the code size by performing re-quantization using a different quantization step value, Q.sub.1 =Q2 does not hold. As a result, quantization errors occur during the decoding process for inter macroblocks. Thus, motion compensation errors occur in coded P-pictures and B-pictures in inter macroblocks.

Detailed Description Text (145):
In the motion compensation error corrector 42 of the image information conversion apparatus 40 according to the second embodiment, motion compensation error correction coefficients are generated and subtracted from the discrete cosine transform coefficients dequantized by the inverse quantizer 26 thereby correcting the motion compensation errors.

Detailed Description Text (154):
In the image information conversion apparatus 40 according to the second embodiment of the present invention, as described above, it is possible to reduce the code size (bit rate) by treating the data in each block in the frequency domain, and thus the amount of calculation becomes small compared with that required by the conventional image information conversion apparatus in which image information is decoded into baseband video data and then coded again. Therefore, it is possible to construct the image information conversion apparatus 40 into a very simple form. Furthermore, the image information conversion apparatus 40 is capable of reduce the code size without generating degradation in image quality caused by the accumulation of motion compensation errors.

Detailed Description Text (161):
Third Embodiment of an Image Information Conversion Apparatus

Detailed Description Text (162):
A third embodiment of an image information conversion apparatus according to the present invention is described below.

Detailed Description Text (163):
FIG. 32 is a block diagram of the third embodiment of the image information conversion apparatus according to the present invention. In this third embodiment of the image information conversion apparatus, similar elements to those of the first embodiment of the image information conversion apparatus 20 or to those of the second embodiment of the image information conversion apparatus 40 are denoted by similar reference numerals, and they are not described in further detail herein.

Detailed Description Text (164):
The image information conversion apparatus 50 shown in FIG. 34 includes a code buffer 23, a compressed information analyzer 24, a variable length decoder 25, an inverse quantizer 26, an adder 41, a band limiter 27, a quantizer 28, a variable length coder 29, a code buffer 30, a code size controller 31, and a motion compensation error corrector 51.

Detailed Description Text (179):
In the image information conversion apparatus 50, as described above, the compensation error correction is performed for low-frequency components of 8.times.8 discrete cosine transform coefficients in the horizontal direction and for all components in the vertical direction, and correction is not performed for high-frequency components in the horizontal direction, because errors in the low-frequency components are more significant. Generally, there is a small probability that a large error occurs in high-frequency components in the horizontal direction. Furthermore, high-frequency components in the horizontal direction are removed by the band limiter 27. Therefore, no significant degradation in picture quality occurs even if the error correction for high frequency-components in the horizontal direction is not performed. In contrast, as for components in the vertical direction, when the input compressed image information is generated by means of interlaced scanning, information as to the time difference between fields is contained in high-frequency components. Therefore, it is desirable to perform the motion compensation error correction upon all components in the vertical direction over the entire frequency range.

Detailed Description Text (180):
In the image information conversion apparatus 50 according to the third embodiment of the present invention, as described above, it is possible to reduce the code size (bit rate) by treating the data in each block in the frequency domain, and thus the amount of calculation becomes small compared with that required by the conventional image information conversion apparatus in which image information is decoded into baseband video data and then coded again. Therefore, it is possible to construct the image information conversion apparatus 50 into a very simple form. Furthermore, the image information conversion apparatus 50 is capable of reduce the code size without generating degradation in image quality caused by the accumulation of motion compensation errors. Because the motion compensation error corrector 51 does not generate motion compensation error correction coefficients for high-frequency components in the horizontal direction, a further reduction in the amount of calculation is achieved.

Detailed Description Text (192):
As described above, the present invention has great advantages. That is, in the method and apparatus for converting image information according to the present invention, orthogonal transform coefficients are first dequantized and then re-

quantized using a different quantization step value. Because the image signal is processed in the frequency domain without being decoded into a baseband signal, it is possible to reduce the bit rate by performing a small amount of calculation using a simple circuit. Another advantage of the present invention is that the bit rate can be reduced without generating significant distortion or degradation in image quality caused by re-quantization.

Detailed Description Text (193):
In the method and apparatus for converting image information according to another aspect of the present invention, after limiting high-frequency components of the dequantized orthogonal transform coefficients, the orthogonal transform coefficients are re-quantized using a different quantization step value. This makes it possible to further reduce the bit rate without generating significant distortion or degradation in image quality caused by re-quantization. In the method and apparatus, information in the vertical direction, which included difference information between fields, is not limited thereby allowing the bit rate to be reduced without generating significant degradation in image quality.

Detailed Description Text (194):
In the method and apparatus for converting image information according to the present invention, the orthogonal transform coefficients may be dequantized and then re-quantized using a different quantization step value, and, furthermore, motion compensation may be performed upon the difference between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation. This makes it possible to reduce the code size without generating degradation in image quality caused by accumulation of motion compensation errors due to re-quantization.

Detailed Description Text (195):
In the method and apparatus for converting image information according the present invention, after limiting high-frequency component values of the dequantized orthogonal transform coefficients in the horizontal direction, the re-quantization may be performed using a different quantization step value, and furthermore, motion compensation may be performed upon the differences in the low-frequency 4 coefficients in the vertical direction and 8 coefficients in the-vertical direction between the input orthogonal transform coefficients and the re-quantized orthogonal transform coefficients thereby correcting errors caused by motion compensation. This makes it possible to reduce the code size without generating degradation in image quality caused by accumulation of motion compensation errors due to re-quantization. Furthermore, a reduction in the circuit scale is achieved.

CLAIMS:

1. An image information conversion apparatus for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than said first bit rate, said first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by said orthogonal transform, within said block, each said block being a predetermined pixel block (orthogonal transform block), said image information conversion apparatus comprising: dequantization means for dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; band limiting means for limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized by said dequantization means; and quantization means for re-quantizing the orthogonal transform coefficients dequantized by said dequantization means, using a quantization step value which is set so that the output second compressed image information has said second bit rate.

2. An image information conversion apparatus according to claim 1, wherein said band limiting means limits orthogonal coefficients for a color difference signal over a range whose lower limit is lower than for a luminance signal.

3. An image information conversion apparatus according to claim 1, further comprising: compressed image information analysis means for analyzing the code size of each picture in the input first compressed image information; and code size control means for controlling the code size of the output second compressed image information, by controlling the quantization step value employed by said quantization means, wherein said code size control means determines the target code size (target bit rate) T of each picture of the second compressed image information in accordance with the following equation:

$$T=B(R2/R1)$$

where R1 is said first bit rate and R2 is said second bit rate.

4. An image information conversion apparatus according to claim 1, further comprising: variable length decoding means for performing variable length decoding upon the input first compressed image information; and variable length coding means for performing variable length coding upon the compressed image information re-quantized by said quantization means, wherein said variable length coding means performs said variable length coding by scanning each orthogonal block in an alternate fashion thereby converting each orthogonal block into a one-dimensional signal.

5. An image information conversion apparatus for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than said first bit rate, said first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by said orthogonal transform, within said block, each said block being a predetermined pixel block (orthogonal transform block), said image information conversion apparatus comprising: first dequantization means for dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; band limiting means for limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized by said first dequantization means; addition means for adding motion compensation error correction coefficients to the orthogonal transform coefficients dequantized by said first dequantization means; quantization means-for re-quantizing the orthogonal transform coefficients including motion compensation error correction coefficients added by said addition means, using a quantization step value which is set so that the output second compressed image information has said second bit rate; second dequantization means for dequantizing the orthogonal transform coefficients re-quantized by said quantization means; subtraction means for subtracting the orthogonal transform coefficients including motion compensation error correction coefficients added by said addition means from the orthogonal transform coefficients dequantized by said second dequantization means thereby generating quantization error coefficients in the frequency domain; and motion compensation error correction means for generating the motion compensation error correction coefficients by means of: performing an orthogonal transform upon the subtracted orthogonal transform coefficients and performing motion compensation in accordance with a motion vector; and performing an inverse orthogonal transform upon the motion-compensated values.

6. An image information conversion apparatus according to claim 5, wherein said band limiting means limits orthogonal coefficients for a color difference signal over a range whose lower limit is lower than for a luminance signal.

7. An image information conversion apparatus according to claim 5, wherein said motion n compensation error correction means does not perform the inverse orthogonal transform and the orthogonal transform upon orthogonal transform coefficients which have been converted to 0 by said band limiting means.

8. An image information conversion apparatus according to claim 5, further comprising: compressed image information analysis means for analyzing the code size of each picture in the input first compressed image information; and code size control means for controlling the code size of the output second compressed image information, by controlling the quantization step value employed by said quantization means, wherein said code size control means determines the target code size (target bit rate) T of each picture of the second compressed image information in accordance with the following equation:

T=B(R2/R1) where R1 is said first bit rate and R2 is said second bit rate.

9. An image information conversion apparatus according to claim 5, further comprising: variable length decoding means for performing variable length decoding upon the input first compressed image information; and variable length coding means for performing variable length coding upon the compressed image information re-quantized by said quantization means, wherein said variable length coding means performs said variable length coding by scanning each orthogonal block in an alternate fashion regardless of the scanning method of the input first compressed image information, thereby converting each orthogonal block into a one-dimensional signal.

10. An image information conversion apparatus according to claim 5, wherein said motion compensation error correction means generates motion compensation error correction coefficients for P-pictures but does not generates motion compensation error correction coefficients for B-pictures.

11. An image information conversion apparatus according to claim 5, wherein said motion compensation error correction means performs the inverse orthogonal transform and the orthogonal transform in accordance with fast algorithm.

12. An image information conversion apparatus according to claim 5, wherein said orthogonal transform coefficients consist of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, that is, 8.times.8 coefficients, and wherein said motion compensation error correction means comprises: a 4.times.8 inverse orthogonal transformer for performing a 4.times.8 inverse orthogonal transform upon quantization error coefficients consisting of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, thereby generating quantization error values in the space domain; a motion compensator for performing motion compensation upon the space-domain quantization error values generated by said 4.times.8 inverse orthogonal transformer, with precision of 1/4 pixels in the horizontal direction and 1/2 pixels in the vertical direction thereby generating quantization error correction values in the space domain; and a 4.times.8 orthogonal transformer for performing a 4.times.8 orthogonal transform upon the space-domain quantization error correction values generated by said motion compensator thereby generating said motion compensation error correction coefficients in the frequency domain.

13. An image information conversion apparatus according to claim 12, wherein said 4.times.8 inverse orthogonal transformer performs the inverse orthogonal transform after replacing high-frequency components of the orthogonal transform coefficients of a color difference signal in the vertical direction with 0.

14. An image information conversion apparatus according to claim 12, wherein: said motion compensation error correction means includes an interpolator for interpolating, with precision of 1/4 pixels in the horizontal direction, the space-

domain quantization error values generated by said 4.times.8 inverse quantizer; and said motion compensator performs motion compensation in the horizontal direction using the interpolated values generated by said interpolator.

15. An image information conversion apparatus according to claim 12, wherein: said 4.times.8 inverse orthogonal transformer performs a 4th order inverse orthogonal transform for only low-frequency 4 coefficients of 8th order quantization error coefficients in the frequency domain in the horizontal direction, and said 4.times.8 inverse orthogonal transformer performs an 8th order inverse orthogonal transform in the horizontal direction; and said 4.times.8 orthogonal transformer performs a 4th order orthogonal transform in the horizontal direction and an 8th order orthogonal transform in the vertical direction, upon the space-domain motion compensation error correction values.

16. An image information conversion apparatus according to claim 12, wherein: said 4.times.8 inverse orthogonal transformer performs the inverse orthogonal transform in the horizontal direction in such a manner that an 8th order inverse orthogonal transform is performed after replacing, with 0, higher-frequency 4 coefficients of 8th order quantization error coefficients in the frequency domain in the horizontal direction, and then 4th order quantization error values in the space domain are generated by means of partial removal or by means of averaging; and said 4.times.8 orthogonal transformer performs the orthogonal transform in the horizontal direction in such a manner that a discrete cosine transform is performed after generating 8 motion compensation error correction values by interpolating 4 motion compensation error correction values in the space domain.

17. An image information conversion method for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than said first bit rate, said first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by said orthogonal transform, within said block, each said block being a predetermined pixel block (orthogonal transform block), said image information conversion method comprising the steps of: inputting said first compressed image information with the first bit rate; dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized in said dequantization step; re-quantizing the orthogonal transform coefficients dequantized in said dequantization step, using a quantization step value which is set so that the output second compressed image information has said second bit rate; and outputting the second compressed image information generated in said re-quantization step.

18. An image information conversion method for converting first compressed image information with a first bit rate to second compressed image information with a second bit rate lower than said first bit rate, said first compressed image information having been produced by coding an image signal into a compressed form by means of performing an orthogonal transform on a block-by-block basis and then quantizing orthogonal coefficients, obtained by said orthogonal transform, within said block, each said block being a predetermined pixel block (orthogonal transform block), said image information conversion method comprising the steps of: inputting said first compressed image information with the first bit rate; dequantizing the orthogonal transform coefficients, in accordance with the quantization step value of the orthogonal transform coefficients of the input first compressed image information; limiting high-frequency component values, in the horizontal direction, of the orthogonal transform coefficients dequantized in said dequantization step; adding motion compensation error correction coefficients to said orthogonal transform coefficients; re-quantizing the orthogonal transform coefficients including motion compensation error correction coefficients added in said addition

step, using a quantization step value which is set so that the output second compressed image information has said second bit rate; outputting the second compressed image information generated in said re-quantization step; generating the motion compensation error correction coefficients by: dequantizing said re-quantized orthogonal transform coefficients; subtracting the orthogonal transform coefficients including the added motion compensation correction coefficients from the dequantized orthogonal transform coefficients; performing an orthogonal transform upon the subtracted orthogonal transform coefficients and performing motion compensation in accordance with a motion vector; and performing an inverse orthogonal transform upon the motion-compensated values.

19. An image information conversion apparatus according to claim 18, wherein said orthogonal transform coefficients consist of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, that is, 8.times.8 coefficients, and wherein said frequency-domain motion compensation error correction coefficients are generated by: performing a 4.times.8 inverse orthogonal transform upon quantization error coefficients consisting of 8 coefficients in the horizontal direction by 8 coefficients in the vertical direction, thereby generating quantization error values in the space domain; performing motion compensation upon said space-domain quantization error values, with precision of 1/4 pixels in the horizontal direction and 1/2 pixels in the vertical direction thereby generating quantization error correction values in the space domain; and performing a 4.times.8 orthogonal transform upon said quantization error correction values in the space-domain.